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GB 2232936 A GB 2220620 A GB 1381999 A
EP 0411979 A

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(54) **Vehicle impact sensor arrangement**

(57) A vehicle impact sensor arrangement comprises a sensor (1) having a first part (3) adapted to be fixed in position and a second part (9) positioned adapted to move in response to deformation of the outer skin of a motor vehicle. If the second part (9) moves with a predetermined speed a safety device (2) in the form of an air-bag is activated. In response to movement of the second part a stab engages and ignites a pyrotechnic charge (4) which triggers activation of the safety device (2). The arrangement may be positioned in a vehicle side door.

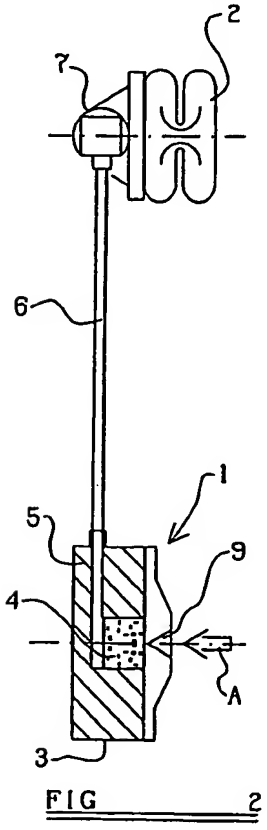

FIG 2

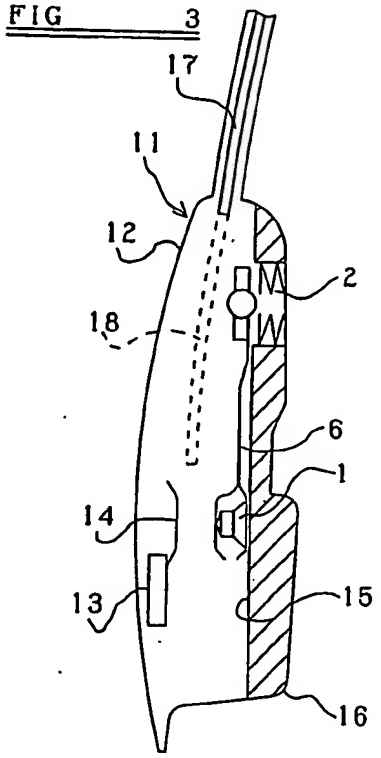

FIG 3

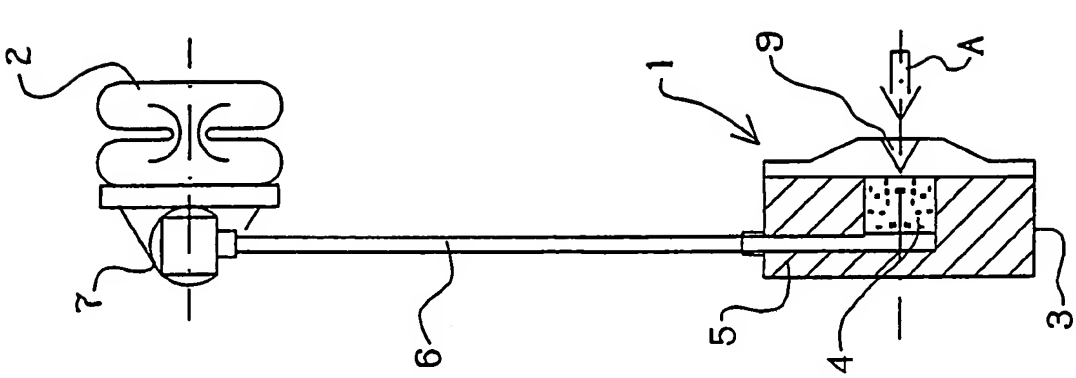

FIG 2

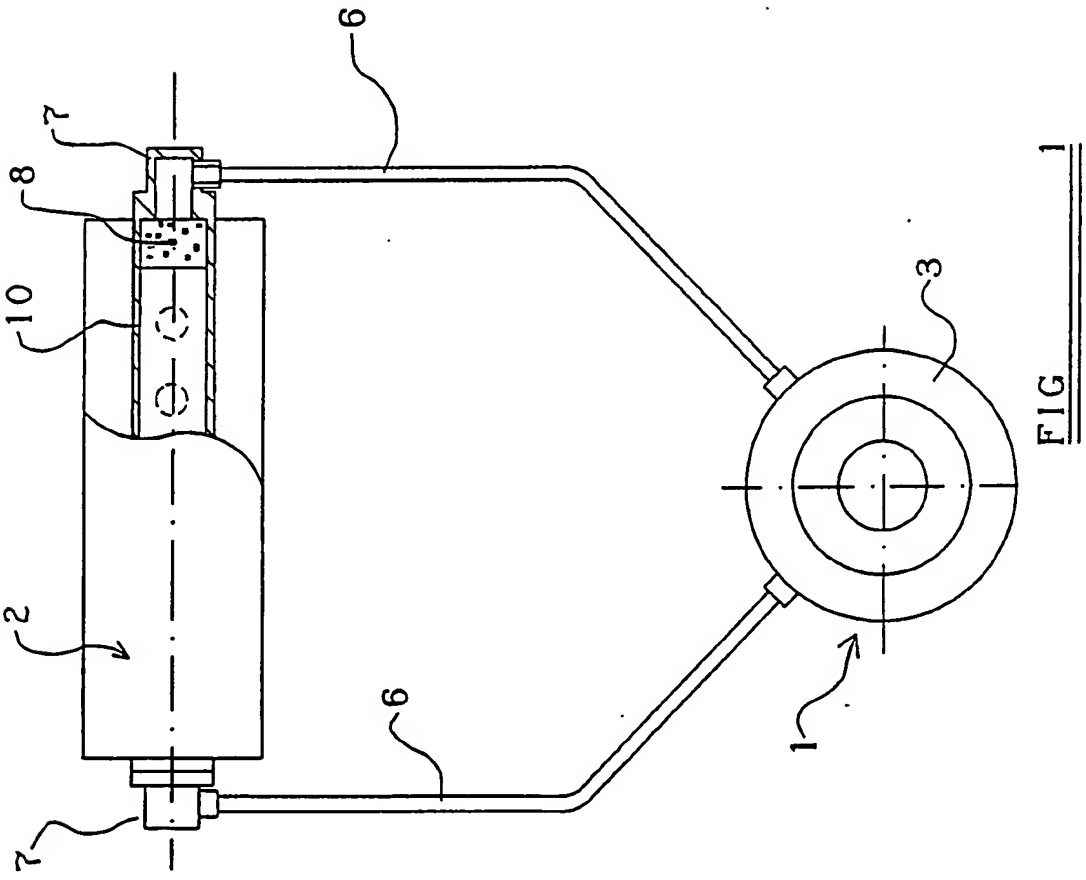

FIG 1

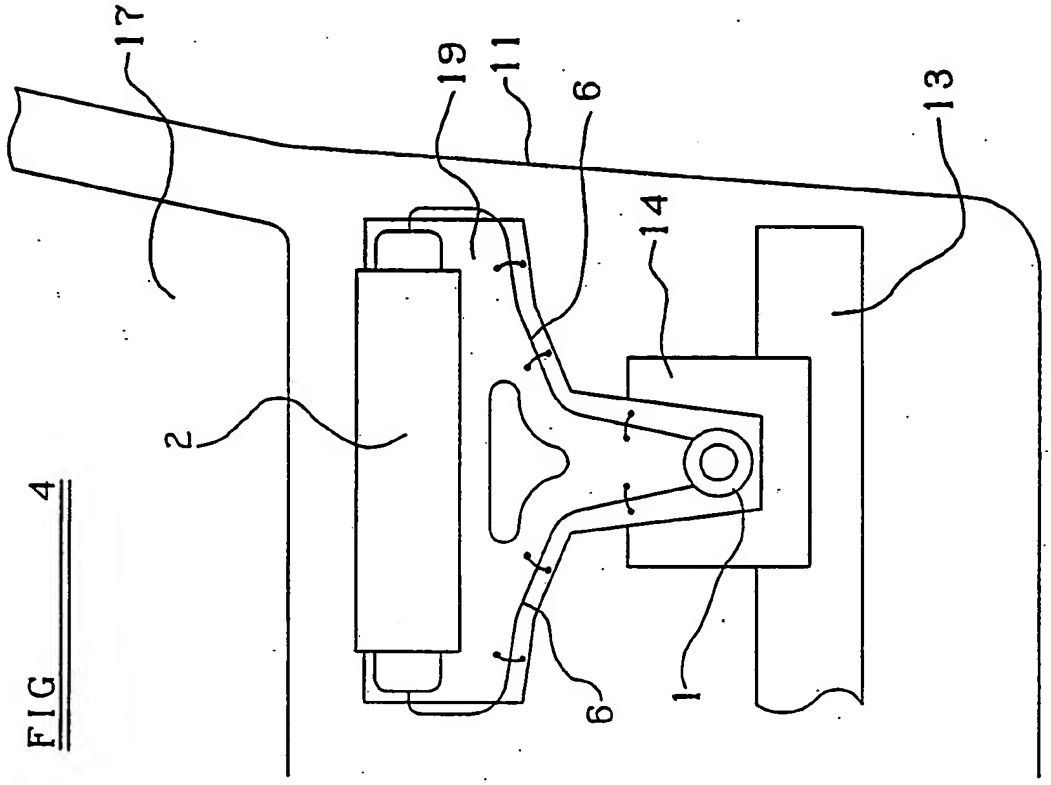

FIG 4

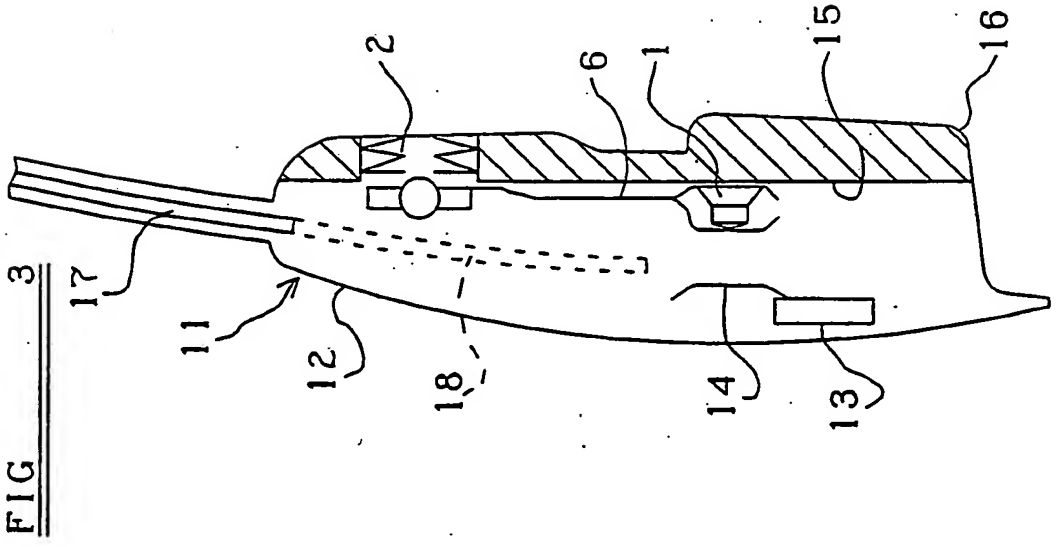

FIG 3

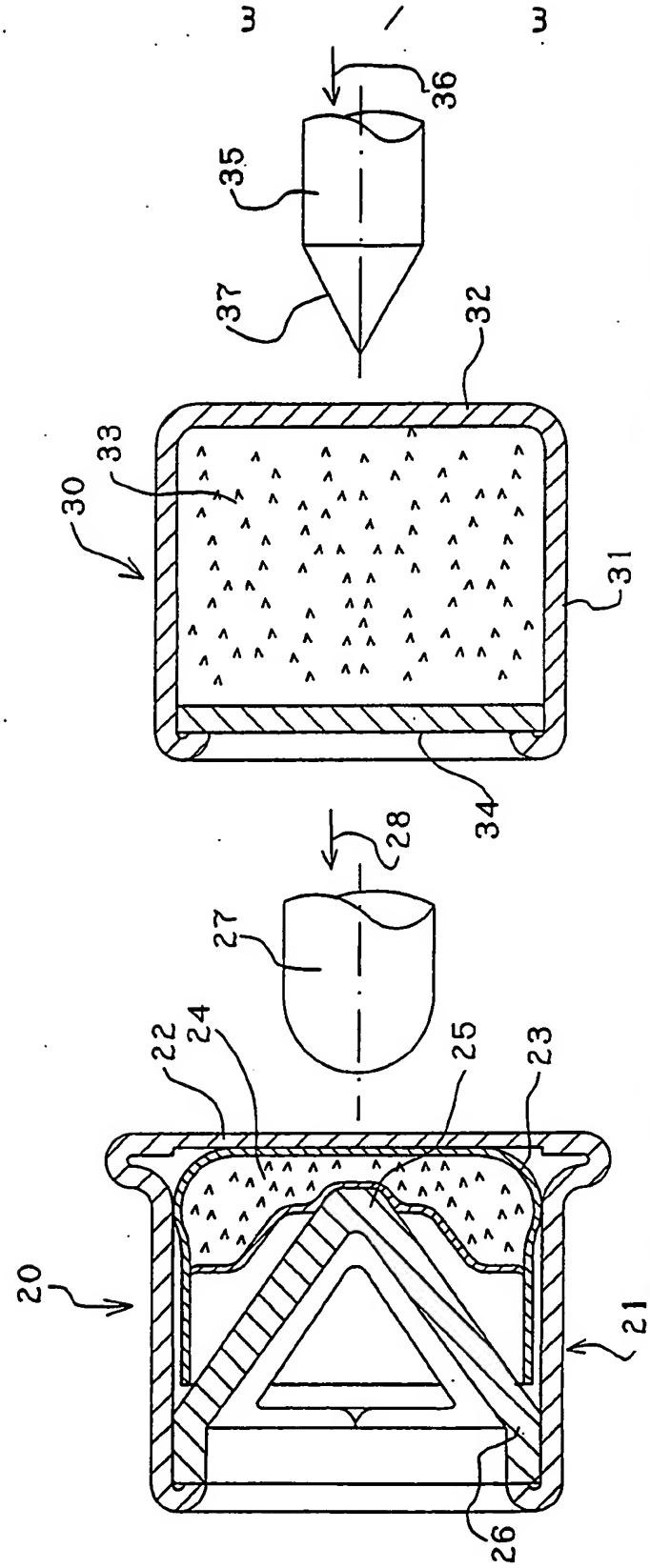

FIG 6

FIG 5

DESCRIPTION OF INVENTION

"Improvements in or relating to a Vehicle Impact Sensor Arrangement"

THE PRESENT INVENTION relates to a vehicle impact sensor arrangement and more particularly relates to a vehicle impact sensor arrangement adapted to sense an impact on a vehicle and to activate a safety device within the vehicle such as an air-bag or a seat belt pre-tensioner.

When a vehicle, such as a motor car, is involved in an accident, if the vehicle is subjected to an impact or collision, the vehicle can decelerate rapidly. In such a situation a person travelling within the vehicle may continue to move at the original speed of the vehicle, due to inertia and may thus impact with part of the vehicle which has decelerated. For example, if a vehicle is subjected to a front impact, by crashing into a fixed object, the main body of the vehicle may stop relatively rapidly, whilst a person in the vehicle continues to travel forwardly, the person travelling in the vehicle thus, in effect, being thrown forwardly on to a fixed part of the vehicle, such as the steering wheel or the dash board. A similar situation exists if a vehicle is subjected to a side impact.

It has thus been proposed to provide sensors which sense an impact or collision or rapid deceleration of a vehicle, and which activate safety devices such as air-bags or seat belt pre-tensioners.

Many sensors have been proposed previously, and a significant proportion of these sensors operate to provide an electrical signal responsive of the impact. The electrical signal is utilised to trigger the air-bag or the seat belt pre-tensioner. One problem that exists where an electrical triggering system is used is that sometimes a totally "spurious" signal can be generated, due to "noise" or due to external electro-magnetic radiation, which means that the air-bag or seat belt pre-tensioner can be operated when there is no collision or impact. If the car is being driven at the time, this can seriously distract the driver, and indeed, if an air-bag is inflated, the air-bag may well impair the vision of the driver.

A further disadvantage of sensors which provide a "electric" signal is that it is often the case that during a major impact the electrical supply of the vehicle may be impaired very shortly after commencement of the impact. Thus, such sensors may fail to operate satisfactorily in a real accident situation.

During an impact, the outer skin of the vehicle moves relative to a fixed inner part of the vehicle, the chassis of the vehicle. The severity of the impact is related to the speed with which the outer skin of the vehicle moves relative to a fixed part of the vehicle. It is thus desired to be able to provide a sensor which responds to the speed of movement of the outer skin of the vehicle relative to a fixed part of the vehicle, particularly in the case of a sensor adapted and located to detect a side impact.

According to one aspect of this invention there is provided a sensor for sensing an impact on a motor vehicle and for activating a safety device within the vehicle, the

sensor being located between the outer skin of the vehicle and an inner part of the vehicle which is relatively fixed in position, the sensor being adapted to be activated when the outer skin of the vehicle moves at a speed greater than a predetermined speed relative to said fixed part of the vehicle, the device being non-electric.

Preferably the sensor comprises two pasrts, one being supported by the said inner part of the vehicle, the other being located to be moved in response to movement of the outer skin of the vehicle.

According to another aspect of this invention there is provided a sensor for sensing an impact on a vehicle and for activating a safety device in the vehicle, said sensor comprising a first part in the form of a housing containing pyrotechnic material and a second part in the form of a stab, a sensor being located adjacent the outer skin of the vehicle and having one part supported by an inner part of the vehicle which is relatively fixed in position and the other part being adapted to be moved in response to movement of hte outer skin of the vehicle during an impact, the arrangement being such that in an impact situation the stab is moved into an engagement with the housing or the pyrotelchnic material with a speed related to the speed of movement of the outer skin, the arrangement being such that the pyrotechnic material ignites when the speed of movement of the vehicle skin exceeds a predetermined level.

The sensor may be provided in combination with a safety device, the safety device being activated by a pyrotechnic charge. The safety device may comprise an air-bag or a pre-tensioner for a safety belt. The sensor may be connected to the safety device by a high speed fuse or by a shock tube.

Preferably the sensor is mounted in a door of a motor vehicle adapted to respond to a side impact and the safety device is in the form of an air-bag also mounted in the door adapted, when inflated, to be located between the door and a person sitting in the motor vehicle adjacent the door.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a front view, with parts cut away, of a sensor arrangement in accordance with the invention associated with an air-bag,

FIGURE 2 is a side view, again with parts cut away, of the arrangement of Figure 1,

FIGURE 3 is a sectional view taken through a door of a motor vehicle showing the arrangement of Figures 1 and 2 in use,

FIGURE 4 is a view from the inside of the door, with the inner cladding of the door removed,

FIGURE 5 is a diagrammatic view of one embodiment of percussion initiator, and

FIGURE 6 is a schematic view of another form of percussion initiator for use with the invention.

Referring now to the drawings, Figures 1 and 2 illustrate a sensor arrangement 1 associated with an air-

bag 2. The sensor arrangement 1 consists of a substantially solid housing 3 which defines an inner chamber 4 substantially open to one side of the housing, which contains an appropriate pyrotechnic material. The open end of the chamber may be closed by a thin membrane. Passages 5 leads from the chamber 4, these passages each containing one end of a high speed fuse cord, such as the fuse cord sold under the designation "NONEL". In the embodiment illustrated two passages 5 are provided in the housing, a respective fuse cord 6 passing through each passage. Each fuse cord 6 passes to a gas generator housing 7 which contains a further pyrotechnic charge 8. The gas generator housings 7 are located at opposite ends of a perforated tube 9 which passes through part of the air-bag 2. The air-bag 2 is initially in a collapsed or un-inflated condition.

A stab 9 is provided located adjacent the recess 4 which contains a pyrotechnic material. As will be described hereinafter the sensor 1 is located so that in an impact situation the stab 9 is driven into the recess 4, as generally indicated by the arrow 10. Due to the friction effect between the stab 9 and the pyrotechnic material within the cavity 4, the temperature of teh pyrotechnic material near the stab is elevated and the pyrotechnic material is ignited. The fuses 6 are thus ignited. The fuses form a high speed path for the ignition, and the ignition can travel along this path at speeds between 2,000 and 8,000 metres per second. Consequently, the pyrotechnic charge 8 within each gas generator housing 7 is very rapidly ignited. These pyrotechnic charges generate gas which pass through the apertures formed in the aperture tube 9 to inflate the air-bag 2.

From the description given above it will be appreciated that the described arrangement is totally non-electric, in that no electric signals are utilised whatsoever, and the system is not dependent upon the functioning of the main electric supply system of the vehicle.

Turning now to Figures 3 and 4, the system described above with reference to Figures 1 and 2 is now illustrated in position within a door of a motor vehicle. Thus, the sensor is located in position adapted to sense a side impact. The air-bag is mounted in the door and is adapted to form a cushion between the door and the person sitting adjacent the door in the event that a side impact arises.

Thus Figures 3 and 4 illustrate schematically a door 11 of a motor vehicle. The door presents an outer skin 12, this outer skin being relatively thin and thus being deformed in a side impact. Located adjacent the outer skin 12 is a reinforcing bar 13, and the reinforcing bar 13 carries an extension plate 14. The extension plate 14 is located adjacent the sensor assembly 1 which is fixed in position on the inner skin 15 of the door. The inner skin 15 carries padding and interior lining 16. The high speed fuse 6 is mounted within the interior cavity of the door, and the air-bag 2 is mounted in position on the inside of the door adjacent the lower part of the window 17 provided in the door. The window 17 may be lowered, when it occupies a position 18 as shown in phantom.

Referring now to Figure 4, it can be seen that the sensor 1, the fuses 6 and the air-bag assembly 2 are mounted in position on a support plate 19 which is located in the interior cavity of the door.

It is to be appreciated that in the event that a side impact occurs, the reinforcing bar 13 will be deflected, thus bringing the force transmitting plate 14 into contact with the sensor assembly 1. The sensor assembly will thus be triggered, with the stab engaging the pyrotechnic material, and the air-bag 2 will then be inflated.

Figures 5 and 6 illustrate two alternate embodiments of the sensor which could be used in place of the sensor assembly 1 described above.

Referring initially to Figure 5, a sensor assembly 20 comprises an outer housing 21 of generally cylindrical form having a flexible closed end 22. Contained within the housing is a sack 23 which contains pyrotechnic material 24. The sack rests over the apex 25 of the conical rigid member 26 which is located within the housing 21. The rigid conical member 26 is firmly mounted in position. A stab 27 is provided for use with the arrangement illustrated, the stab being adapted to move towards the flexible end 22 of the cylindrical housing 21 in the direction indicated by the arrow 28 in the event that in impact occurs. The stab 27 will contact the flexible end 22 of the housing and will thus compress a pyrotechnic material 25 against the end 25 of the conical member 26. If the stab is moving with sufficient speed, heat will be generated within the pyrotechnic material as part of the pyrotechnic material is compressed between, effectively, the end of the stab and the apex 25 of the conical member 26. The degree of heat depends upon the speed of compression of the pyrotechnic material and once the appropriate temperature is reached within the pyrotechnic material, the pyrotechnic material 24 will be ignited.

Figure 6 illustrates a modified arrangement 30 in which a cylindrical housing 31 is provided having a closed end 32. The housing contains pyrotechnic material 33 which is retained within the housing by a means of a closure disc 34. A sharp pointed stab 35 is provided for use with this sensor arrangement, the stab moving towards the sensor arrangement in the direction indicated by the arrow 36 in the event of an impact. The pointed end 37 of the stab 35 will penetrate the closure 32 of the cylindrical housing 31, and the pointed end 37 of the stab will then engage the pyrotechnic material 33. A frictional effect will exist between the pointed end 37 of the stab and the pyrotechnic material, this frictional effect generating heat dependent upon the speed of the stab 35 relative to the pyrotechnic material 33. If the speed of the stab is sufficient, the frictional effect will generate sufficient heat to initiate the pyrotechnic material 33.

It is thus to be understood that in the described embodiments of the present invention, the pyrotechnic material within the sensor 1, 20 or 30 is effectively ignited when the speed of the stab 9, 27 or 35 exceeds a predetermined limit. The speed of a stab does exceed this limit the frictional effect between the stab and the pyrotechnic material, or the deformation effect of the pyrotechnic material in the case of the embodiment of Figure 5, is such that the degree of heat generated is adequate to ignite the pyrotechnic material. Of course, a true percussion pyrotechnic material could be used, ignited by the shock wave when the stab engages the pyrotechnic material. Once the pyrotechnic material within the sensor 1, 20 or 30 has been ignited, the high speed fuse 6 will be ignited and will almost instantaneously ignite the pyrotechnic charge 8 within the gas generator 7 of the air-bag 2.

Whilst the invention has been described with reference to certain embodiments it is to be appreciated that many modifications may be effected without departing from the scope of the invention. Instead of using a high speed detonator fuse, it would be possible to utilise a "shock tube" between the sensor and the pyrotechnic charge in the gas generator. In this type of arrangement the pyrotechnic material present within the sensor would be adapted to detonate on activation of the sensor, thus generating a shock wave. The pyrotechnic material in the gas generator would be selected to be triggered by such a shock wave. A shock tube would serve to transfer the shock wave from the pyrotechnic material in the sensor to the pyrotechnic material in the gas generator.

Whilst the invention has been described with specific reference to an arrangement to detect a side impact, the invention is not restricted to such an arrangement, since the invention could be utilised to detect a front impact or a rear impact. Also, while the invention has been described with reference to the inflation of an air-bag in response to a sensed impact, it is to be appreciated that the sensor of the invention may be utilised in conjunction with a seat belt pre-tensioner.

It is to be appreciated that the sensor of the invention is adapted to be mounted in position between a fixed part of the vehicle and the outer skin of the vehicle, and is responsive to the speed of deformation of the outer skin of the vehicle relative to the fixed part of the vehicle. If the speed of deformation is not large, the stab will not generate sufficient heat to activate the pyrotechnic material and thus the sensor will not activate the safety device. It is only when the speed of deformation of the skin of the vehicle is sufficiently

great to generate the necessary heat within the pyrotechnic material to ignite the pyrotechnic material that the sensor activates the safety system.

CLAIMS:

1. A sensor for sensing an impact on a motor vehicle and for activating a safety device within the vehicle, the sensor being located between the outer skin of the vehicle and an inner part of the vehicle which is relatively fixed in position, the sensor being adapted to be activated when the outer skin of the vehicle moves at a speed greater than a predetermined speed relative to said fixed part of the vehicle, the device being non-electric.

2. A sensor arrangement according to Claim 1 wherein the sensor comprises two parts, one being supported by the said inner part of the vehicle, the other being located to be moved in response to movement of the outer skin of the vehicle.

3. A sensor for sensing an impact on a vehicle and for activating a safety device in the vehicle, said sensor comprising a first part in the form of a housing containing pyrotechnic material and a second part in the form of a stab, a sensor being located adjacent the outer skin of the vehicle and having one part supported by an inner part of the vehicle which is relatively fixed in position and the other part being adapted to be moved in response to movement of the outer skin of the vehicle during an impact, the arrangement being such that in an impact situation the stab is moved into an engagement with the housing or the pyrotechnic material with a speed related to the speed of movement of the outer skin, the arrangement being such that the pyrotechnic material ignites when the speed of movement of the vehicle skin exceeds a predetermined level.

4. A sensor according to Claim 3 in combination with a safety device, the safety device being activated by a pyrotechnic charge.

5. A sensor and safety device combination according to Claim 4 wherein the safety device is an air-bag.

6. A sensor and safety device combination according to Claim 4 wherein the safety device is a pre-tensioner for a safety belt.

7. A sensor and safety device combination according to any one of the Claims 4 to 6 wherein the sensor is connected to the safety device by a high speed fuse.

8. A sensor and safety device combination according to any one of Claims 4 to 6 wherein the sensor is connected to the safety device by means of a shock tube.

9. A safety device and sensor combination according to any one of Claims 4 to 8 wherein the sensor is mounted in a door of a motor vehicle adapted to respond to a side impact and the safety device is in the form of an air-bag also mounted in the door adapted, when inflated, to be located between the door and a person sitting in the motor vehicle adjacent the door.

10. A sensor arrangement substantially as herein described with reference to Figures 1 to 4 of the accompanying drawings.

11. A sensor device substantially as herein described with reference to and as shown in Figures 1 to 4 as modified by Figure 5 of the accompanying drawings.

12. A sensor device substantially as herein described with reference to and as shown in Figures 1 to 4 of the accompanying drawings as modified by Figure 6.

13. Any novel feature or combination of features disclosed herein.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9109943.2

Relevant Technical fields

(i) UK Cl (Edition K) B7B (BSB)

(ii) Int Cl (Edition 5) B60R

Search Examiner
PAT EVERETT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
16 SEPTEMBER 1991

Documents considered relevant following a search in respect of claims 1-12

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2232936 (AUTOLIV) - page 4 lines 14-27	1
X	GB 2220620 (GENERAL ENGINEERING) - page 7 lines 1-15	1
X	GB 1381999 (PORSCHE) - page 2 lines 32-35	1
X	EP 0411979 (RENAULT) - Figures 3 and 4	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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